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The effect of soil quality on phosphate, nitrite, nitrate, pH, water retention and its effects on germination, leaf production and flowering of Arabidopsis thaliana

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Growth Conditions

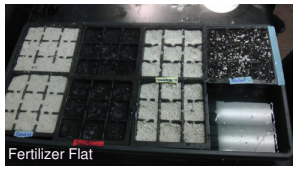
Day temp: 20°C Night temp: 18°C
16 hr light, 8 hr dark

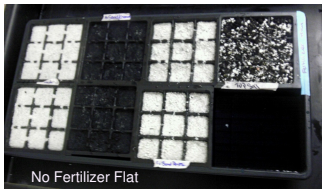
Percival Model: 136VL
Environmental Chamber

Treatments

7 Treatments:

Flats	Sand (100% sand)	Sand/Charcoal (50/50)	Sand/ perlite (50/50)
No fertilizer	18 plants	18 plants	18 plants
50 ppm fertilizer (2x)	18 plants	18 plants	18 plants
Potting soil (control) 9 plants			


Fertilizer Flat

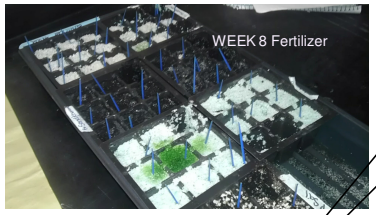

No Fertilizer Flat

Abstract

Arabidopsis thaliana (Columbia) was exposed to 4 different soil types (100% sand, 50/50 sand and perlite, 50/50 sand/charcoal and standard potting mix) in the presence and absence of fertilizer. In the fertilizer treatment, the plants were exposed to a 50 ppm fertilizer at two and four weeks after planting. Leaf number and length of largest leaf were measured once a week throughout eight weeks of the experiment. Twice during the experiment, soil concentration of phosphates, nitrates, nitrates and pH was measured. Water retention was tested once in the beginning of the experiment each day for seven days. Most plants in the high fertilizer treatment died after the second treatment. The plants in the no fertilizer treatment grew slowly. The control plants, grown in potting mix without fertilizer showed the most growth. Only the plants grown in pure sand, without fertilizer, flowered.

Hypothesis

Soil composition will affect the availability of water and nutrients and, therefore, the likelihood that Arabidopsis thaliana will flower.



"Altering soil properties including physical, chemical and biological ones can influence plant growth and yield production."
-Dr. Mohammad Miransari

Results

Figure 1: Analysis of Mortality Rate
Low Fertilizer 1 November 22, 2011

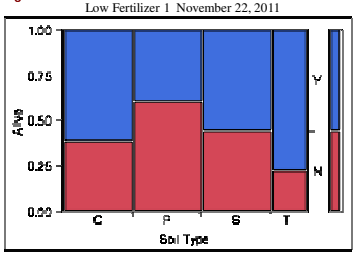
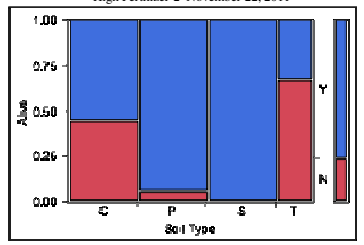


Figure 2: Analysis of Mortality Rate
High Fertilizer 2 November 22, 2011



Low fertilizer treatment had no significant effect on mortality

Figure 3: Water and nutrient retention by soil type.

Treatment 1	Phosphate (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	pH	Days Till Dry
Low Fertilizer					
sand	4.0	35.2	0.33	7.01	12 Days
sand/perlite	4.6	30.8	0.09	6.58	12 Days
sand/charcoal	6.3	24.2	0.01	7.54	12 Days
Potting soil	6.3	22.0	0.34	5.32	12 Days
High Fertilizer					
sand	10.3	148	1.56	6.98	14Days
sand/perlite	7.3	215	1.36	7.58	14Days
sand/charcoal	8.3	158	1.17	8.51	14Days
Potting soil	10.3	146	1.28	7.25	13 Days

Figure 4a: Estimated Change in Number of Leaves Compared to Potting Soil, Low Fertilizer

	Mean Leaf #	Prob>|t|
Potting Soil	5.9883117	<.0001
Soil (C)	-3.806494	0.0079
Soil (P)	-2.131169	0.1801
Soil (S)	-3.788312	0.0100

Figure 4b: Estimated Change in Leaf Length Compared to Potting Soil, Low Fertilizer

	Mean Leaf Length	Prob>|t|
Intercept	3.087013	<.0001
Soil (C)	-1.996104	0.0160
Soil (P)	-0.515584	0.5746
Soil (S)	-1.787013	0.0343

Conclusions

1. Fertilizer treatment killed plants in all soil compositions, except potting soil and charcoal.
2. Plants grew best in control conditions (no fertilizer, potting soil).
3. Of the no fertilizer treatments, only plants in perlite did not differ significantly from plants grown in potting soil.
4. Nutrient and water retention, as measured in our experiment was a poor predictor of plant growth and mortality.

Acknowledgements

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